

when the shaft chain is at the two extreme positions of its bending range. For example, when the shaft chain achieves a 360-degree rotation range, preferably, as shown in FIG. 4, the baffle 23 formed on the connecting element 22 is symmetrical with respect to the line O-O' of the centers of the two shaft holes on the connecting element 22. Thus the shaft chain can rotate 180 degrees symmetrically towards both sides from the straight state rotating respectively and thus rotate 360 degrees altogether. This is particularly suitable for hinge apparatus, such as notebook computers, mobile phones and so on. It can be understood that the positions of projection 21 and the baffle 23 can be provided in other ways so as to achieve other desired shapes when the shaft chain is at the two extreme positions of its bending range.

It can be understood that the connecting means between the shaft 20 and the connecting element 22 can also be used in other embodiments described below.

FIG. 4 is a schematic diagram schematically showing the hinge apparatus 200 according to another exemplary embodiment of the present invention. In FIG. 4, portions that are the same with those of the foregoing embodiments are omitted. As shown in the figure, in the hinge apparatus 200, each shaft 30 extends from left to right. For example, it can extend to the width that can be substantially throughout the members (not shown) to be connected, and each two adjacent shafts are connected to each other through the connecting element at least in the vicinity of both ends of the shaft 30. Since the shaft 30 extends to the width that is substantially throughout the members (not shown) to be connected, the hinge apparatus 200 has a good synchronization characteristics. It can be understood that the hinge apparatus 200 of FIG. 4 is similar with that in the case where the maximum number of the simultaneous bridges are set in the hinge apparatus 100.

FIGS. 5A, 5B and 5C illustrate the various usage states of the electronic device comprising the hinge apparatus according to an embodiment of the present invention. The electronic device can be, for example, a notebook computer 110. The notebook computer 110 comprises a first body 112, a second body 114, and a hinge apparatus 116 connecting the first body 112 and the second body 114. The hinge apparatus 116 can be a hinge apparatus according to any preceding embodiment or other embodiments of the present invention.

As shown in FIG. 5A, the hinge apparatus 116 can place the first body 112 and the second body 114 in the same plane. In this case, as shown in FIG. 5A, the hinge apparatus 116 and the shaft chain (not shown) comprised in the hinge apparatus 116 can be in a substantially flat state.

The first body 112 can rotate from the position shown in FIG. 5A counterclockwise to the position shown in FIG. 5B through a hinge apparatus 116, in order to provide a conventional computer usage state. Also, the first body 112 can continue to rotate counterclockwise with respect to the second body 114 through the hinge apparatus 116 until rotating 180 degrees, so as to be in a closed state (not shown).

In addition, the first body 112 can also rotate from the position shown in FIG. 5A clockwise to the position shown in FIG. 5C through a hinge apparatus 116. In this case, the second body 114 can be placed on the desktop as a base, and the first body 112 is operated as a pad computer to provide the pad computer, sometimes referred to as ("PAD") usage pattern. It can be understood that the first body 112 can continue to rotate clockwise with respect to the second body 114 through the hinge apparatus 116 until rotating 180 degrees, so that the entire computer can have an appearance the same with a PAD. That is, the first body 112 and the second body 114 can rotate 360 degrees with respect to each other through the hinge apparatus 116.

As described above, an even rotation angle of each shaft can be achieved by providing projections and bafflers (see FIG. 3) in the hinge apparatus 116. The bafflers can be provided symmetrically so that a shape symmetry can be achieved when the hinge apparatus 116 rotates 180 degrees clockwise and counterclockwise.

As shown in FIGS. 5B and 5C, the electronic device 110 can provide different operating modes based on its different folding forms. For example, it can switch between the conventional computer mode and the PAD mode. In different operating modes, the display interfaces are different and the operating modes are different. For example, in the notebook computer mode, it is operated through a conventional keyboard, while in the PAD mode it is operated through a touch screen. Those skilled in the art can understand that the switching can be achieved through the manual operation of a switch, and it can also be achieved automatically by providing a sensor to detect the folding state of the electronic device 110.

In one embodiment, the first body 112 and the second body 114 have a set of hardware system, and have an operating system installed. The set of hardware system and operating system provide different operating modes, wherein one is a working mode suitable for operating by using a keyboard and a touchpad; the other is a working mode suitable for operating by touching. The user interfaces in the two working modes are different. Each is suitable for its own operating mode respectively and does better than supporting the other operating mode.

In another embodiment, the first body 112 and second body 114 can have one set of hardware system and have two sets of operating systems installed. In different operating modes, the set of hardware system can run in different operating systems. For example, these two operating systems can be WINDOWS system and ANDROID system, APPLE MAC OS system and IOS system, and so on. Different operating systems lead to different user interfaces and operating modes.

In yet another embodiment, the first body 112 and the second body 114 can have different hardware systems and have different operating systems installed. For example, the first body 112 has the ARM hardware system and the operating system based on the ARM hardware system, such as, ANDROID system, IOS and the like. The second body 114 can have the X86 hardware system and the operating system based on the X86 hardware system, such as WINDOWS system, APPLE MAC OS, etc. In the present embodiment, when the operating mode is switched, not only is the operating system switched, but the hardware system is also switched.

Although a number of exemplary embodiments of the present invention are described above, it can be understood that the present invention is not limited to the disclosed exemplary embodiments. Instead, within the spirit and scope of the present invention, those skilled in the art can make various changes in forms and details. The present invention is intended to cover all such modifications and variations. The spirit and scope of the present invention is defined only by the appended claims and their equivalents.

What is claimed is:

1. A hinge apparatus, comprising:

n shafts, arranged side by side, wherein n is an integer equal to or greater than 3 and each shaft includes a projection; multiple connecting elements for rotatably connecting each two adjacent shafts so as to form a shaft chain, wherein each connecting element comprises a baffle and at least two shaft holes each shaft hole receiving one of the two adjacent shafts,